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This study, dealing with the institutional influences in undergraduate training of Ph. D. chemists, arrives at institutional ranking by utilizing a Ph. D.-bachelor index, i.e., the proportion of the number of chemistry-major baccalaureate graduates who earned a Ph. D. in chemistry or biochemistry. Institutional comparisons cover: Type of institution, geographic location by region, institutional control (public and private), accreditation, per student outlay, financial success of graduates, ratio of faculty to graduates, and professional publications.

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INSTITUTIONAL INFLUENCES IN UNDERGRADUATE TRAINING OF PH.D. CHEMISTS

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In recent years a number of articles have appeared in various journals ranking institutions of higher education in order of their success in training scientists. Several of these studies were concerned with scientists in general, while others dealt with a specific science such as chemistry or physics.[2] Essentially, these studies arrived at their ranking by determining the proportion of male graduates earning a Ph.D. in science.

In the opinion of the writer this is an unrealistic and unreliable method of determining the efficiency of an institution in training scientists. An index based on total enrollment or total male graduates includes so many people without training, contact, or interest in science that it becomes almost meaningless. An index of this nature depends to a large extent on the number of curricula offered by the institution. This factor gives a great advantage to the colleges, since their total number of male graduates does not include graduates from professional courses such as engineering, business administration, or law. This fact may be illustrated by considering the proportion of graduates with chemistry majors from each of the various groups of institutions.

In the academic year 1948–49, 1.9 per cent of the baccalaureate graduates from universities majored in chemistry. The percentage from colleges was over two and one-half times as great, with 4.9 per cent. The percentages for teachers colleges and technical schools were 1.8 and 1.4, respectively.[3] There is also considerable difference among individual institutions in the same classification. In the school year 1948–49, 25.3 per cent of male graduates of Hope College were chemistry majors. In the same year only 1.5 per cent of male graduates from Swarthmore were chemistry majors.[4]

Because of these factors it seemed to the writer that the only index which would be reliable in measuring the efficiency of an institution in the undergraduate training of scientists must be based on the number of baccalaureate graduates with a major in the science being considered. With this in mind, a study was undertaken to determine what proportion of the chemistry graduates of individual institutions obtained a doctorate in chemistry or biochemistry.

A study of this nature entailed a search for two types of data. First, it was necessary to determine a source which would give the baccalaureate origin of chemistry doctorates by institution. Second, it was necessary to determine by institution the number of chemistry baccalaureate graduates for the years in which these chemistry doctorates completed their undergraduate training.

The first part of this search ended with the Trytten report.[5] This study determined the baccalaureate sources of individuals awarded the doctoral degrees in the sciences in the United States during the decade January 1, 1936, to December 31, 1945, inclusive. A study related to the Trytten report has been previously published in THIS JOURNAL.[6]

The Research Staff on Scientific Personnel of the American Council on Education has found that the typical number of years between bachelor's and doctor's degrees for scientists was four.[7] Therefore, the years 1932-41 were accepted as the years during which the majority of the 1936–45 chemistry doctorates received their baccalaureate degrees.

The search for a single source which could give the number of chemistry baccalaureate degrees by institution for these years was a futile one. The only possible sources for such information were the colleges themselves. A questionnaire was prepared, asking the heads of chemistry departments of the respective in-

[1] Present address: Wisconsin State College, Milwaukee, Wisconsin.

[2] COOPER, J. N., *Am. J. Phys.*, **20**, 200–2 (1952); GOODRICH, H. B., R. H. KNAPP, AND A. W. BOEHM, *Sci. American*, **185**, 15–17 (July, 1951); KNAPP, R. H., AND H. B. GOODRICH, *Science*, **113**, 543–45 (1951); LEWIS, H. F., J. CHEM. EDUC., **28**, 104–7 (1951); LEWIS, H. F., *Journal of Higher Education*, **22**, 297–304 (1951).

[3] The data used to determine these percentages were obtained from the U. S. Office of Education, "Earned Degrees Conferred by Higher Educational Institutions 1948–49," Circular No. 262, pp. 23–9.

Institutions classified as universities consisted of a liberal arts college and at least two professional schools. All other institutions which offered a liberal arts course were classified as colleges.

A few institutions classified as colleges also offered professional courses in one field. Institutions classified as technical and teachers colleges did not offer liberal arts courses. The type of offering for each institution was determined from the 1936 edition of "American Universities and Colleges" and the 1933-34 edition of the "College Blue Book."

[4] Data used to determine these percentages were obtained from the U. S. Office of Education, *op. cit.*

[5] National Research Council, Office of Scientific Personnel, "The Baccalaureate Origins of the Science Doctorates Awarded in the United States 1936–1945," National Research Council, Washington, D. C., 1948.

[6] LEWIS, H. F., J. CHEM. EDUC., **28**, 104–7 (1951).

[7] American Council on Education Research Staff on Scientific Personnel, "The Production of Doctorates in the Sciences; 1936–1948," American Council on Education, Washington, D. C., 1951.

stitutions to supply this information. With each questionnaire a letter was enclosed explaining the purpose and value of this study and emphasizing the fact that all graduates which the institution considered as having a chemistry major should be included. No attempt was made to define a chemistry major; this was left to the individual institution.

During this period many chemistry majors did not plan a career in chemistry but were looking toward medicine or secondary-school teaching as a life work. The index would probably have been more reliable if it could have been based only on those people who were majoring in chemistry and planning to make it their life work. It was decided, however, that to specify a narrower field for a period so far back would have reduced the per cent of return considerably. Therefore, in order to make the replies uniform, it was necessary to emphasize that all chemistry majors should be included.

Institutions to which this questionnaire was sent were in one or more of the following categories:

(1) Institutions which provided the undergraduate training for five or more chemistry doctorates granted in the 1936–45 period as determined by Trytten.[8]

(2) The 50 most productive schools in the training of scientists as determined by Knapp and Goodrich.[9]

(3) Schools approved by the American Chemical Society.

(4) The 27 most productive liberal arts colleges as determined by Lewis.[10]

It was decided to limit the questionnaires to those institutions which had provided the undergraduate training of five or more doctorates, in order to reduce the mailing expense. In all probability those institutions which provided the undergraduate training for less than five doctorates would not rank very high on a rating scale based on the number of chemistry graduates. It is possible, however, that there are some institutions which provide excellent chemical training for a very small number of students.

All but 12 universities out of the 122 listed by the Trytten report were included in one or more of the above categories; 27 out of the 41 technical schools were included. There were, however, 230 colleges and 52 teacher-training institutions which provided the undergraduate training for less than five chemistry doctorates.

The percentage of return on this questionnaire was unusually high. Eighty-five per cent of the institutions replied, with 66 per cent providing the requested information. By using this information the institutions could be ranked according to the ratio of doctorates in chemistry and biochemistry granted to each institution's baccalaureate graduates in the decade 1936–45 to the number of bachelor's degrees granted to chemistry majors by the institution during the decade 1932–41. The top 50 of this group are presented in Table 1.

On comparison of the ranking presented in this table with the ranking of the Knapp and Goodrich study, one finds there is a small positive correlation. Of the 36 institutions which are included among the top 50 as determined by Knapp and Goodrich and are also included in this study, only 15 rank among the top 50 in Table 1. Probably the most prominent difference between these rankings is that this study places many more universities and technical schools among the top 50. The top 50 schools in the Knapp and Goodrich study consisted of 38 colleges, nine universities, and three technical schools, while the top 50 institutions in Table 1 consist of 21 colleges, 19 universities, and ten technical schools.

The correlation of the liberal arts colleges with the Lewis study[11] is somewhat greater. Here 12 of the 21 colleges which are among the top 27 producers of chemists according to Lewis are among the top 27 in this study.

The low correlation with the Knapp and Goodrich study might be attributed in part to the fact that Knapp and Goodrich included all natural scientists while this study was limited to chemists and biochemists. In the Lewis study, however, where the same type of index was used for chemists and scientists in general, a much closer correlation was obtained. He found that 20 of the top 27 producers of chemists were also among the top 27 producers of scientists in general.

It seems more likely that the low correlation in both instances is a result of the difference in indexes. While the indexes used in this study are based only on the baccalaureate graduates who majored in the same field as the doctorates in question, those of the other two studies are based on all baccalaureate degrees.

An index based on the total number of male graduates depends on two factors: first, on the proportion of male students majoring in chemistry, and second, on the proportion of chemistry majors who later earn a Ph.D. The correlation of each of these factors with an index based on the total number of male graduates was determined for a group of institutions for which the necessary data could be obtained. There was found to be a greater positive correlation between an index based on total male graduates and the proportion of male graduates who majored in chemistry than there was between the index based on total male graduates and the proportion of chemistry majors who later earned the doctorate in chemistry. It is probably safe to say that a ranking which used an index based on total number of male graduates is influenced as much by proportion of male graduates majoring in chemistry as it is by the proportion of graduates earning the doctorate.

Although the ranking of baccalaureate sources of chemists as it appears in Table 1 eliminates some of the defects of previous studies, it may be criticized on the following points:

(1) It is not complete; that is, only two-thirds of

[8] National Research Council, Office of Scientific Personnel, *op. cit.*, pp. 20–60.

[9] KNAPP, R. H., AND H. J. GOODRICH, *Science*, **113**, 543 (1951).

[10] LEWIS, H. F., J. CHEM. EDUC., **28**, 106 (1951).

[11] LEWIS, H. F., J. CHEM. EDUC., **28**, 106 (1951).

TABLE 1

Institutions Ranked by Ratio of Ph.D.'s in Chemistry and Biochemistry Granted Their Graduates, 1936–45, to B.A.'s Granted Their Chemistry Majors, 1932–41

Institution	*Grads. to chem. Ph.D., 1936–45* (1)	*Chem. grads., 1932–41* (2)	(1)/(2) × 100 (3)	*Rank from* (3) (4)	*K.-G. rank* (5)	*Year accred. A. C. S.* (6)	*Class.* (7)
Rice Institute	24	30	80.0	1	...	1940	U
University of Idaho	21	32	65.6	2	...	1940	U
California Institute of Technology	36	74	48.7	3	2	1940	T
University of Notre Dame	40	96	41.7	4	...	1940	U
Calvin College	9	22	40.9	5	...	...	C
Swarthmore	21	53	39.6	6	33	1940	C
Massachusetts Institute of Technology	72	182	39.6	6	...	1940	T
St. Olaf College[a]	27	71	38.0	7	23	1947	C
DePauw University	44	116	37.9	8	8	1941	C
Oberlin College	56	150	37.3	9	5	1940	C
Yale University	54	152	35.5	10	...	1940	U
Carnegie Institute of Technology	25	71	35.2	11	...	1941	T
Alabama Polytechnical Institute	15	45	33.3	12	...	1946	T
Montana State College[b]	30	90	33.3	12	24	1940	T
Catholic University of America	14	43	32.6	13	...	1940	U
Utah State Agricultural College	19	59	32.2	14	25	1947	U
Iowa State College of A. & M. Arts[c]	65	203	32.0	15	...	1940	T
Rensselaer Polytechnic Institute	29	91	31.9	16	...	1940	T
University of Wisconsin	138	436	31.6	17	45	1940	U
Florida Southern College	6	19	31.6	17	...	...	C
Wabash College	18	57	31.6	17	36	1941	C
University of Utah	34	108	31.5	18	...	1940	U
Nebraska Wesleyan University	5	16	31.3	19	9	...	C
University of Pittsburgh	43	139	30.9	20	...	1941	U
Kenyon College	7	23	30.4	21	...	1948	C
University of Illinois	228	786	29.0	22	...	1940	U
Antioch College	20	69	29.0	22	11	1947	C
Georgetown College	8	28	28.6	23	...	...	C
Hiram College	15	53	28.3	24	41	...	C
Evansville College (Ind.)	7	25	28.0	25	...	...	C
Wittenberg College	12	43	27.9	26	...	...	C
Reed College	15	55	27.3	27	1	1941	C
Georgia Institute of Technology[d]	9	34	26.5	28	...	1944	T
State College of Washington	20	79	25.3	29	...	1941	U
University of Texas	50	202	24.8	30	...	1940	U
Oregon State College[e]	27	113	23.9	31	...	1941	U
Pennsylvania State University[f]	99	415	23.9	31	...	1940	U
Monmouth College	26	109	23.9	31	...	1948	C
Dartmouth College	33	143	23.1	32	...	1940	C
Iowa Wesleyan College	10	44	22.7	33	10	...	C
Michigan College of Mining & Technology	5	22	22.7	33	...	1947	T
University of Chicago[g]	124	575	21.7	34	16	1940	U
Kansas State College of Agriculture and Applied Science	26	120	21.7	34	...	1940	T
University of Kentucky	27	126	21.4	35	...	1946	U
Doane College	6	28	21.4	35	...	...	C
Ottawa University	6	28	21.4	35	...	...	C
Montana State University	17	80	21.3	36	...	1950	U
Northwestern University[h]	30	143	21.0	37	...	1940	U
Hamline University	8	39	20.5	38	...	...	C
Harvard University	73	377	19.4	39	...	1940	U

[a] St. Olaf College reported that 30 of the 71 chemistry graduates during the period had earned the doctorate in chemistry.
[b] The number of baccalaureate degrees includes those who received their degrees in industrial chemistry.
[c] The total baccalaureate degrees includes 135 B.S.'s in chemistry and 68 in chemical technology.
[d] Georgia Institute of Technology was formerly known as the Georgia School of Technology.
[e] Oregon State College listed the number of baccalaureate degrees for only eight of the ten years. The number 123 was obtained by multiplying the average of these eight years by ten.
[f] The number of baccalaureate degrees includes the majors from both chemistry departments at Pennsylvania State University.
[g] The University of Chicago listed the number of baccalaureate degrees for only six of the ten years. The number 575 was obtained by multiplying the average for these six years by ten.
[h] Northwestern University listed the number of baccalaureate degrees for only eight of the ten years. The number 143 was obtained by multiplying the average for these eight years by ten.

the institutions credited as the source of five or more chemistry doctorates are included in this study.

(2) This ranking does not take into account the fact that baccalaureate graduates other than chemistry majors, such as chemical engineers, may earn the doctorate in chemistry. There are no data available to determine what fraction of chemistry doctorates did their undergraduate work in fields other than chemistry.

TABLE 2
Composite Ph.D.-Bachelor Ratio for Each Group of Institutions

Type of institution	*No. of institutions* (1)	*Grads. to chem. Ph.D. 1936–45* (2)	*Chem. grads. 1932–41* (3)	*(2)/(3) × 100* (4)
Universities	71	2153	13,982	15.4
Grant Ph.D. in chem.[a]	40	1786	10,807	16.5
Do not grant Ph.D. in chem.	31	367	3,125	11.7
Colleges	96	983	9,374	10.5
Technical schools	18	379	1,773	21.4
Grant Ph.D. in chem.[a]	5	227	612	37.1
Do not grant Ph.D. in chem.	13	152	1,152	13.2
All institutions[b]	190	3548	25,741	13.8
Grant Ph.D. in chem.[a]	47	2016	11,482	17.6
Do not grant Ph.D. in chem.	143	1532	14,259	10.7

[a] Institutions placed in this category granted at least one Ph.D. in chemistry in 1932–41 decade.
[b] These data include five teachers colleges, a classification which does not appear in the table.

However, it is generally believed to be very small.

(3) There are many reasons for majoring in chemistry besides preparation for a career in chemistry. Many of the department heads indicated that a sizable proportion of their chemistry majors were premedical students. The proportion of chemistry majors who are not training to be professional chemists may vary from institution to institution.

UNIVERSITIES, COLLEGES, AND TECHNICAL SCHOOLS

In recent years much has been written about the relative success of these groups of institutions in the training of chemists and scientists in general.

One way of comparing these classes of institutions is to determine a composite Ph.D.-Bachelor ratio for each group, as shown in Table 2.

Table 3 shows that the index calculated in Table 2 is fairly representative of universities, since nearly all of these institutions are credited with five or more chemistry doctorates. The index is not quite as representative of the technical schools, since only 61 per cent of the technical schools are credited with five or more doctorates by Trytten.

TABLE 3
Representation of the Various Groups in Table 2

	Universities	*Colleges*	*Technical schools*
Credited with 5 or more doctorates by Trytten	101	120	25
Included in this study	65	85	16
Credited with less than 5 doctorates by Trytten	21	201	16
Included in this study	6	11	2
One or more chemistry majors 1947–48 U. S. O. E.[a]	130	572	23

[a] U. S. Office of Education, "Earned Degrees Conferred by Higher Educational Institutions, 1947–48," Circular No. 247 (1948), pp. 81–94.

Many colleges offer a chemistry major but are not included in this study. Since a very large percentage of these institutions are credited with less than five doctorates by Trytten, they would probably make the ratio for the colleges much lower than that in Table 2.

From the data presented in the previous tables it becomes evident that the groups of institutions rank in the following order:

(1) Institutions stressing technical training.
(2) Universities.
(3) Colleges.

It is apparent that a greater percentage of the chemistry graduates of institutions offering doctoral work in chemistry earn the Ph.D. degree than do graduates of other institutions. This difference is greatest among the technical schools, as those offering the Ph.D. in chemistry have the amazing ratio of 37.1, which far outranks any other group of institutions. Universities offering the Ph.D. have a ratio of 16.5, which is only slightly greater than the ratio for all universities.

The ranking of these various groups of institutions disagrees with the results of other investigators in this field. Knapp and Goodrich found that with the exception of certain agricultural schools, liberal arts colleges were the richest producers of scientists. Lewis rated the universities first, the colleges a close second, the teachers colleges third, and technical schools last. The writers of the Steelman Report concluded that ". . . in proportion to their enrollment, the prominent universities sent very few of their undergraduates into scientific careers."[12]

VARIOUS FACTORS

Geographical Location. In order to determine the relation of geographical location to productivity of chemists a composite Ph.D.-Bachelor ratio was calculated for each of the four major geographical regions. The Middle West had the highest ratio, followed by the West, East, and South in that order.

Although the South is at the bottom of the major geographical divisions, it should be pointed out that eight of the top 50 institutions in Table 1 are in the South. Knapp and Goodrich listed only three southern institutions among the top 50.

Private and Public Institutions. Upon comparison of institutions by type of control no significant difference could be found between privately and publicly controlled institutions. When the privately controlled institutions were classified as Protestant, Roman Catholic, and non-sectarian, the last was found to be the most successful.

In contrast to the Knapp and Goodrich study this study showed that the Roman Catholic institutions do as well as or better than Protestant-controlled institutions. It should also be noted that several Catholic institutions rank very high (Table 1). University of Notre Dame ranks fourth and Catholic University of

[12] STEELMAN, J. R., "Science and Public Policy," U. S. Government Printing Office, Washington, D. C., 1947, Vol. IV, p. 146.

America ranks fourteenth. Knapp and Goodrich placed no Catholic institutions among the top 50. Lewis ranked St. Thomas twenty-seventh in the production of chemists.

Accreditation by the American Chemical Society. Many smaller colleges have felt that the American Chemical Society has discriminated against the small chemistry department. Certain findings of this study seemed to support this theory; other facts brought out by this investigation discredited it.

Those findings which oppose the claim that the Society discriminates against the small chemistry department are:

(1) The combined ratios of the universities and technical schools are considerably higher than that of the colleges. This applies both to A. C. S.-approved departments and to all departments in general.

(2) The four universities included in this study which were not approved by the Society had a higher composite Ph.D.-Bachelor ratio than the composite ratio of the approved colleges.

Facts brought out by this study which support the claim that the Society discriminates against the small chemistry department are:

(1) Nearly all universities are approved. Although the combined Ph.D.-Bachelor ratio for universities is higher than the combined ratio for colleges, the American Chemical Society has approved many universities with a low Ph.D.-Bachelor ratio.

(2) For equal number of graduates per institution which earn the Ph.D. in chemistry a greater proportion of the universities and technical schools are accredited than colleges are.

(3) For the same Ph.D.-Bachelor ratio a greater proportion of universities and technical schools are approved than colleges.

Thirty colleges were identified with a Ph.D.-Bachelor ratio above 15.1, the combined ratio for A. C. S.-approved institutions. On the basis of productivity, all of these colleges should be eligible for approval; however, only 13 are approved. The two major differences between these two groups of colleges were size and financial resources. The average enrollment was 424 for the nonapproved colleges and 906 for the approved schools. The endowment per student for the approved colleges was $5317 compared to $1690 for the nonapproved colleges. The tuition for the approved colleges was nearly $100 higher than for the nonapproved colleges.[13] The nonapproved schools had much smaller chemistry departments: nine of them (Calvin, Florida Southern, Nebraska Wesleyan, Georgetown, Hiram, Evansville, Iowa Wesleyan, Doane, and Ottawa) had a one-man department. Kenyon College was the only approved college with a one-man department. (Kenyon College now has a three-man department.) These ten colleges have proved conclusively that a one-man department can effectively train professional chemists.

[13] The statistics presented in this paragraph were calculated from data presented in the third edition of the "College Blue Book."

PER-STUDENT OUTLAY

In evaluating or accrediting an institution of higher education, one of the things usually considered is its financial status. In this study it was attempted to discover the relation between the amount of money spent per student by the college and the proportion of chemistry graduates that earn the doctorate in chemistry.

The 1933 edition of the "College Blue Book" lists the per-student college outlay. The editors of this book arrived at these figures by dividing the total operating cost per year by the number of enrolled students.[14]

In determining the correlation between per-student outlay and Ph.D.-Bachelor ratio, the institutions were classified according to type and geographical location.

A small positive correlation was obtained for the eastern and midwestern universities and eastern colleges. The correlation coefficients of the other groups were very near zero except for southern colleges which have a small negative correlation coefficient. No trend could be detected when the data for these groups were plotted.

In general the influence of per-student college outlay ranged from negligible to moderate, having the greatest influence on the eastern institutions and midwestern universities.

FINANCIAL SUCCESS OF GRADUATES

In the book "They Went to College" the authors classified institutions according to prestige and national recognition.[15] They found that graduates of institutions nationally recognized had greater financial success than graduates of institutions which did not enjoy a national reputation. These groups of institutions were compared as to their success in the training of chemists.

All groups which have national recognition except the "famous eastern colleges" have a Ph.D.-Bachelor ratio above 13.8, the ratio for all institutions included in this study. The Big Three, which are top in financial success of their graduates, are surpassed by the technical schools and the Big Ten in the proportion of chemistry graduates who earn the Ph.D.

RATIO OF FACULTY TO GRADUATES

To measure the influence of teaching loads on the training of chemists, the correlation between the ratio of faculty to graduates and the Ph.D.-Bachelor ratio were determined. The graduate-faculty ratio was determined by dividing the average number of graduates per year for 1932–41 by the number of chemistry professors; the latter number was taken from the 1936 edition of "American Universities and Colleges."[16] Since the qualifications and duties of an instructor vary greatly between institutions, only faculty members

[14] BERTRAND, C. J., Director of Research, "The College Blue Book," private communication.

[15] HAVEMANN, E., AND WEST, P. S., "They Went to College," Harcourt, Brace and Co., New York, 1952, pp. 178–9.

[16] MARSH, C. S., "American Universities and Colleges," 3rd ed., American Council on Education, Washington, D. C., 1936.

with the rank of assistant professor or above were considered.

A moderately high inverse correlation was found to exist between the percentage of chemistry graduates who earned the Ph.D. and the number of chemistry majors per chemistry professor.

Professorial Publications. The correlation between the number of articles per professor published in the *Journal of the American Chemical Society* and the Ph.D.-Bachelor ratio was found to determine the relationship between teaching productivity and research productivity.

Admittedly the number of articles published per professor in the *Journal of the American Chemical Society* is a very narrow measure of research productivity as their research value is not uniform. One article may represent the same work as several other articles in the same journal.

There are many other journals which publish chemical research papers; however, the *Journal of the American Chemical Society* is the most representative of all fields of chemistry. Also, it represents a large share of the academic research in chemistry in this country. The number of articles per professor was determined by counting number of articles accredited to each chemistry department in the 1932–41 volumes of the *Journal of the American Chemical Society* and dividing this number by the number of professors in the department; the latter figure was taken from the 1936 edition of "American Universities and Colleges."[17]

Since instructors in many institutions have not completed their training and are not ready to conduct independent research, only those faculty members with the rank of assistant professor or above were included.

The correlation coefficient between these two ratios is +0.40 for those institutions which grant a Ph.D. in chemistry. If the institutions are classified into the four major geographic divisions, thus eliminating regional differences, the eastern and midwestern institutions have correlation coefficients of +0.59 and +0.67, respectively. Since the number of institutions which grant the Ph.D. in chemistry in the south and west is very small, correlation coefficients for those regions were not calculated.

These correlation coefficients are not high mathematically. They are probably as high as one could expect, however, if the number of factors influencing the productivity of an institution are considered. They show that there is a definite positive relationship between research productivity and teaching productivity in institutions granting the chemistry doctorate.

These results are essentially parallel to Casey's study of research activity and quality of teaching in medical schools.[18] He found that a high inverse correlation existed between the percentage of failures of students on state board examinations and the publications of faculty in leading national journals. Little relationship could be found between these two ratios in institutions not granting the Ph.D. in chemistry. For universities not granting the chemistry Ph.D., the correlation coefficient was only +0.15.

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[17] *Ibid.*

[18] CASEY, A. E., *Science*, **96**, 110 (1942).